

CHEMICAL REACTIONS

All chemical reactions have two parts:

(1) A substance that undergoes a reaction is called a _____. In other words, reactants are the substances you start with.

(2) When reactants undergo a chemical change, each new substance formed is called a _____. In other words, the products are the substances you end up with.

The reactants turn into the products.

Reactants → Products

In a chemical reaction, the way atoms are joined is changed. Atoms aren't _____ or destroyed.

WORDS, SYMBOLS AND ABBREVIATIONS

The arrow separates the reactants from the products. The arrow reads “reacts to _____.” The plus sign reads “_____.” (s) after the formula implies the substance is a _____. (g) after the formula implies the substance is a gas. (l) after the formula implies the substance is a _____. (aq) after the formula implies the substance is aqueous, a solid dissolved in _____. _____ used after a product indicates a gas, same as (g). ↓ used after a product indicates a _____, same as (s). _____ indicates a reversible reaction. _____ or _____ shows that heat is supplied to the reaction. _____ is used to indicate a catalyst used supplied, in this case platinum. A catalyst is a substance that _____ a reaction without being changed by the reaction. Enzymes are biological or _____ catalysts.

DIATOMIC ELEMENTS

There are ____ elements that never want to be alone. They form diatomic molecules.

H₂, N₂, O₂, F₂, _____, Br₂, I₂.

(1 + 7 pattern on the periodic table)

SIGNS OF A CHEMICAL REACTION

The following are indications that a chemical reaction has occurred:

formation of a

_____, evolution of

a gas, _____ change,

and absorption or release of

1) Convert the following sentences to chemical equations.

- a) Solid iron (III) sulfide reacts with gaseous hydrogen chloride to form solid iron (II) chloride and hydrogen sulfide gas. _____
- b) Nitric acid dissolved in water reacts with solid sodium carbonate to form liquid water and carbon dioxide gas and sodium nitrate dissolved in water.
- _____

2) Convert the following chemical equations to sentences.

- a) $\text{Fe (s)} + \text{O}_2 \text{ (g)} \rightarrow \text{Fe}_2\text{O}_3 \text{ (s)}$ _____
- _____
- b) $\text{Cu (s)} + \text{AgNO}_3 \text{ (aq)} \rightarrow \text{Ag (s)} + \text{Cu(NO}_3)_2 \text{ (aq)}$ _____
- _____

BALANCING EQUATIONS

Atoms can't be _____ or destroyed. All the atoms we start with we must end up with. A balanced equation has the same number of each element on both _____ of the equation.

Rules for Balancing

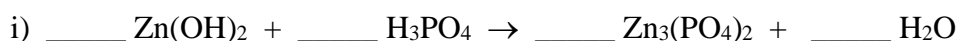
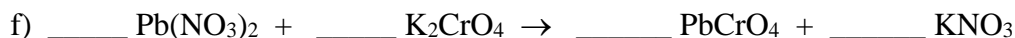
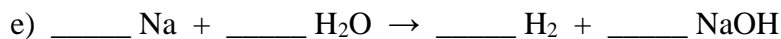
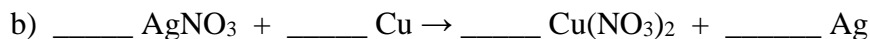
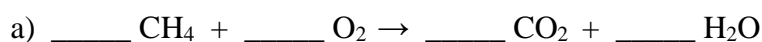
- Write the correct formulas for all the reactants and products.
- Count the number of atoms of each type appearing on both sides.
- Balance the elements one at a time by adding coefficients (the numbers in front).
- Check to make sure it is balanced.

Never change a _____ to balance an equation. If you change the formula you are describing a different reaction. Never put a coefficient in the middle of a formula. 2NaCl is okay; Na_2Cl is not.

Coefficients are used as _____. Balance elements in the following order: (1) metals; (2) nonmetals; (3) hydrogen; and (4) oxygen. If an atom appears more than once on a side, balance it _____.

If you fix everything except one element, and it is even on one side and odd on the other, double the first number, then move on from there.

3. Balance the following equations.



TYPES OF REACTIONS

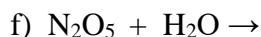
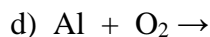
Reactions fall into $\underline{\hspace{1cm}}$ categories:

1. Synthesis
2. Decomposition
3. Single replacement
4. Double replacement
5. Combustion

4) Write and balance the following synthesis reactions.



HINT: Use iron (II).



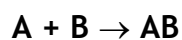
SYNTHESIS REACTIONS

Whenever two or more substances combine to form $\underline{\hspace{2cm}}$ single product, the reaction is called a synthesis reaction.

Key: **M** = Metal ; **NM** = Nonmetal

1. SYNTHESIS:

a. Formation of binary compound:

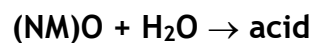


b. Metal oxide and water:



(A base is a metallic $\underline{\hspace{2cm}}$.)

c. Nonmetal oxide and water:

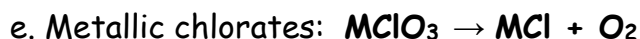
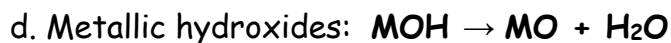


(The acid will be a $\underline{\hspace{2cm}}$ acid.)

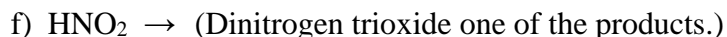
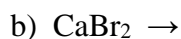
Always remember to check the oxidation numbers of the ions in the product to see if you need to criss-cross before balancing.

DECOMPOSITION REACTIONS

The word decompose implies the compound will "fall apart." In a decomposition reaction, one compound breaks down into _____ or more simpler substances.



5) Use the Chemistry Reference Tables to write and balance the following decomposition reactions.



SINGLE REPLACEMENT

In a single-displacement reaction, one element takes the place of another in a compound. One reactant must be an element, and the other reactant must be a _____. The products will be a different element and a different compound. Remember zinc, Zn, always forms a _____ ion doesn't need parenthesis. In addition, silver, Ag, always forms a _____ ion. Some single replacement reactions do not occur because some elements are not as _____ as others. A more active element _____ a less active element. There is a list referred to as the Activity Series on page 7 of your Chemistry Reference Packet. A higher element on the list replaces lower element. If the element by itself is lower on the list, the reaction will _____ occur.

SINGLE REPLACEMENT, CONT.

- a. Metal-Metal replacement: $A + BC \rightarrow AC + B$
- b. Active metal replaces H from water: $M + H_2O \rightarrow MOH + H_2$
- c. Active metal replaces H from acid: $M + HX \rightarrow MX + H_2$
- d. Halide-Halide replacement: $D + BC \rightarrow BD + C$

6. Write and balance the following single replacement reactions.

- a) $Rb + AlN \rightarrow$
- b) $Zn + HCl \rightarrow$
- c) $Ag + CoBr_2 \rightarrow$
- d) $Ag + H_2O \text{ (steam)} \rightarrow$
- e) $Cu + H_2SO_4 \rightarrow$
- f) $Cr + H_3PO_4 \rightarrow$ (HINT: Use Cr^{3+})
- g) $Ca + H_2O \text{ (steam)} \rightarrow$
- h) $Br_2 + KCl \rightarrow$
- i) $Cl_2 + KI \rightarrow$

DOUBLE REPLACEMENT

In double-displacement reactions, the positive portions of two _____ compounds are interchanged. The reactants must be two ionic compounds or _____. Double replacement reactions usually take place in _____ solution. The _____ ions change place. You must check to see if you need to criss-cross the products and then balance. A double replacement reaction will only happen if one of the products: (1) doesn't dissolve in water and forms a _____, (2) is a _____ that bubbles out, or (3) is a _____ compound usually water.

DOUBLE REPLACEMENT: $AB + CD \rightarrow AD + CB$

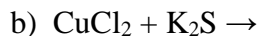
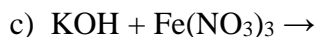
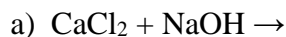
- a. Formation of a precipitate from solution
- b. Acid-Base neutralization

NET IONIC EQUATIONS

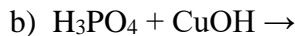
In molecular equations, the formulas of the compounds are written as though all species existed as molecules or whole units. An ionic equation shows dissolved _____ compounds in terms of their free ions. Ions that are not involved in the overall reaction are called _____ ions. The net ionic equation indicates only the species that actually take part in the reaction. The following steps are useful for writing ionic and net ionic equations:

- 1) Write a balanced _____ equation for the reaction.
- 2) Rewrite the equation to indicate which substances are in ionic form in solution. Remember that all soluble salts (and other strong electrolytes), are completely dissociated into _____ and anions. This procedure gives us the ionic equation.
- 3) Lastly, identify and cancel spectator ions on both sides of the equation to arrive at the net ionic equation.

7. Write and balance the following double replacement reactions. Assume the reaction takes place. In addition, identify the precipitate and write the net ionic equation.

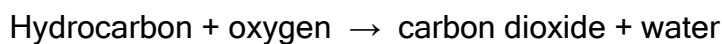


8. Write and balance the following acid-base double replacement reactions.



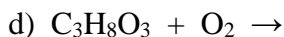
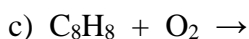
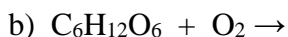
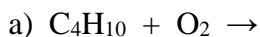
COMBUSTION

A combustion reaction is one in which a substance rapidly combines with _____ to form one or more oxides. Combustion reactions involve a compound composed of only _____ and H (and maybe O) that is reacted with oxygen gas. If the combustion is complete, the products will be CO₂ and _____. Combustion reactions produce heat, and are therefore considered _____ reactions.



A hydrocarbon is a compound that contains both _____ and carbon.

9. Complete and balance the following combustion reactions.



How to Recognize Which Reaction Type: Look at the reactants. (E = element; C = compound)

E + E or oxide + water

Synthesis

C

Decomposition

E + C

Single replacement

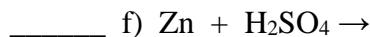
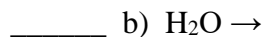
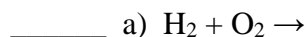
C + C

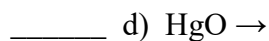
Double replacement

hydrocarbon + O₂

Combustion

10. Identify whether the reaction is synthesis (S), decomposition (D), single replacement (SR), double replacement (DR) or combustion (C).

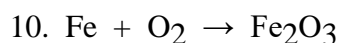
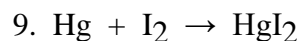
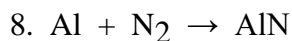
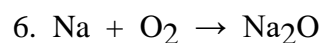
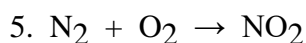
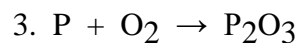
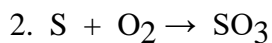
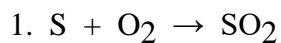




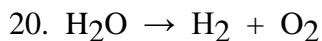
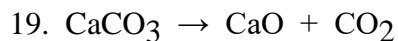
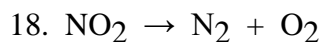
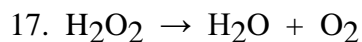
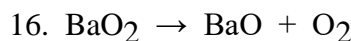
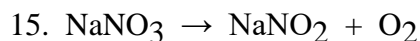
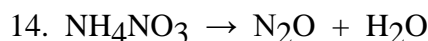
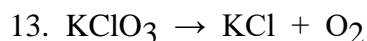
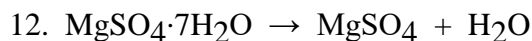
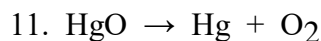
BALANCING EQUATIONS WORKSHEET

On your own paper, balance the following equations.

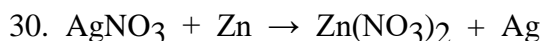
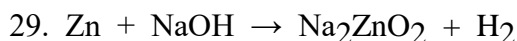
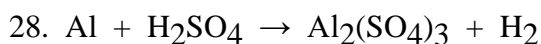
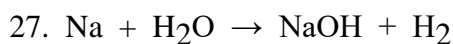
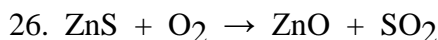
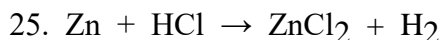
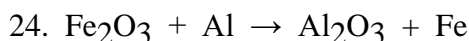
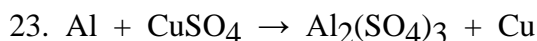
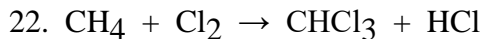
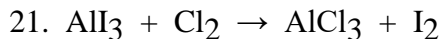
SYNTHESIS



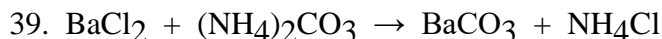
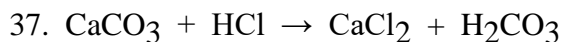
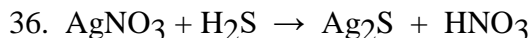
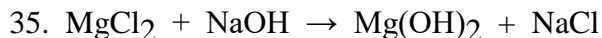
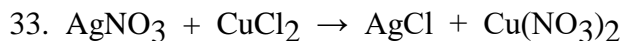
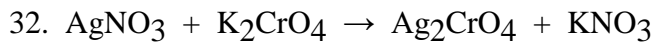
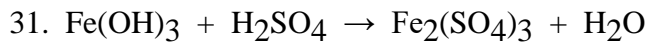
DECOMPOSITION



SINGLE REPLACEMENT (SINGLE DISPLACEMENT)



DOUBLE REPLACEMENT



COMBUSTION

